S8-20

Appendix M

N92-10052

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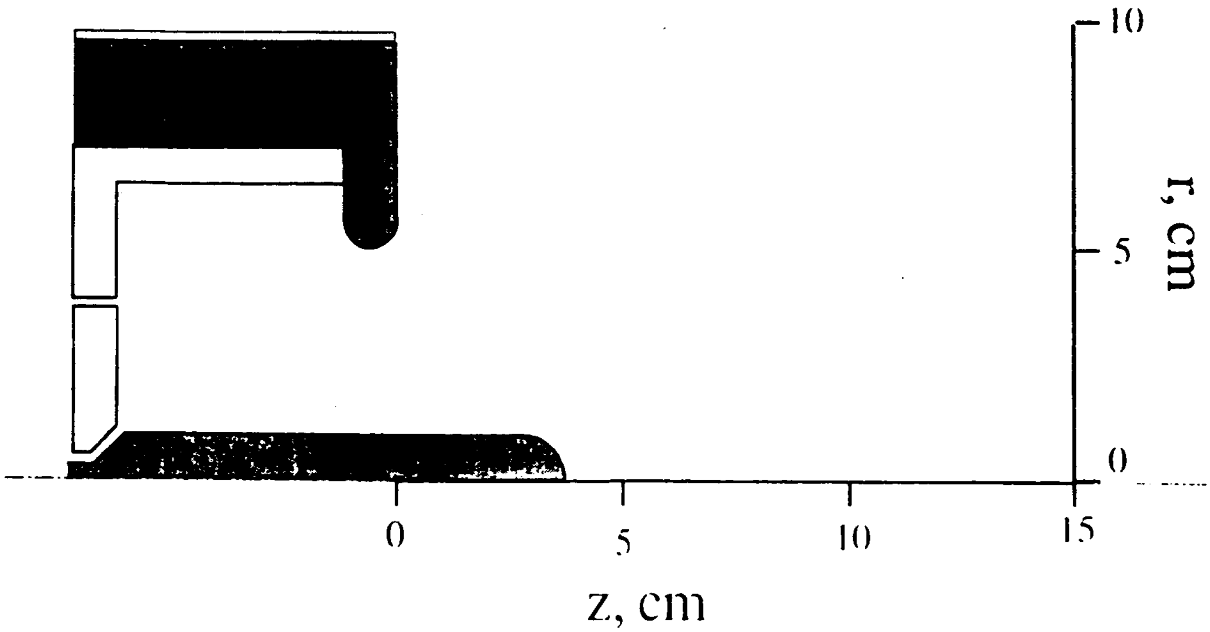
P372212

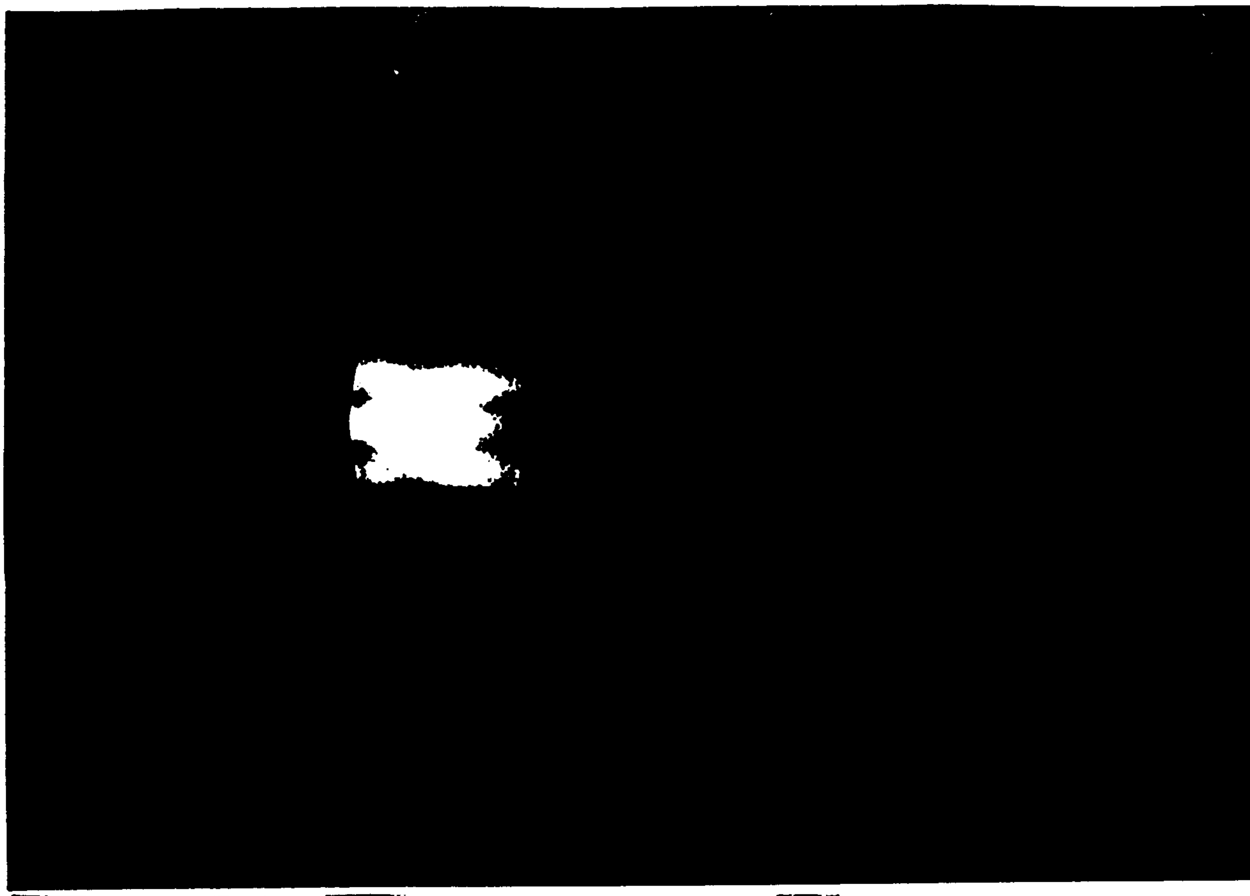
Electric Propulsion & Plasma Dynamics Lab

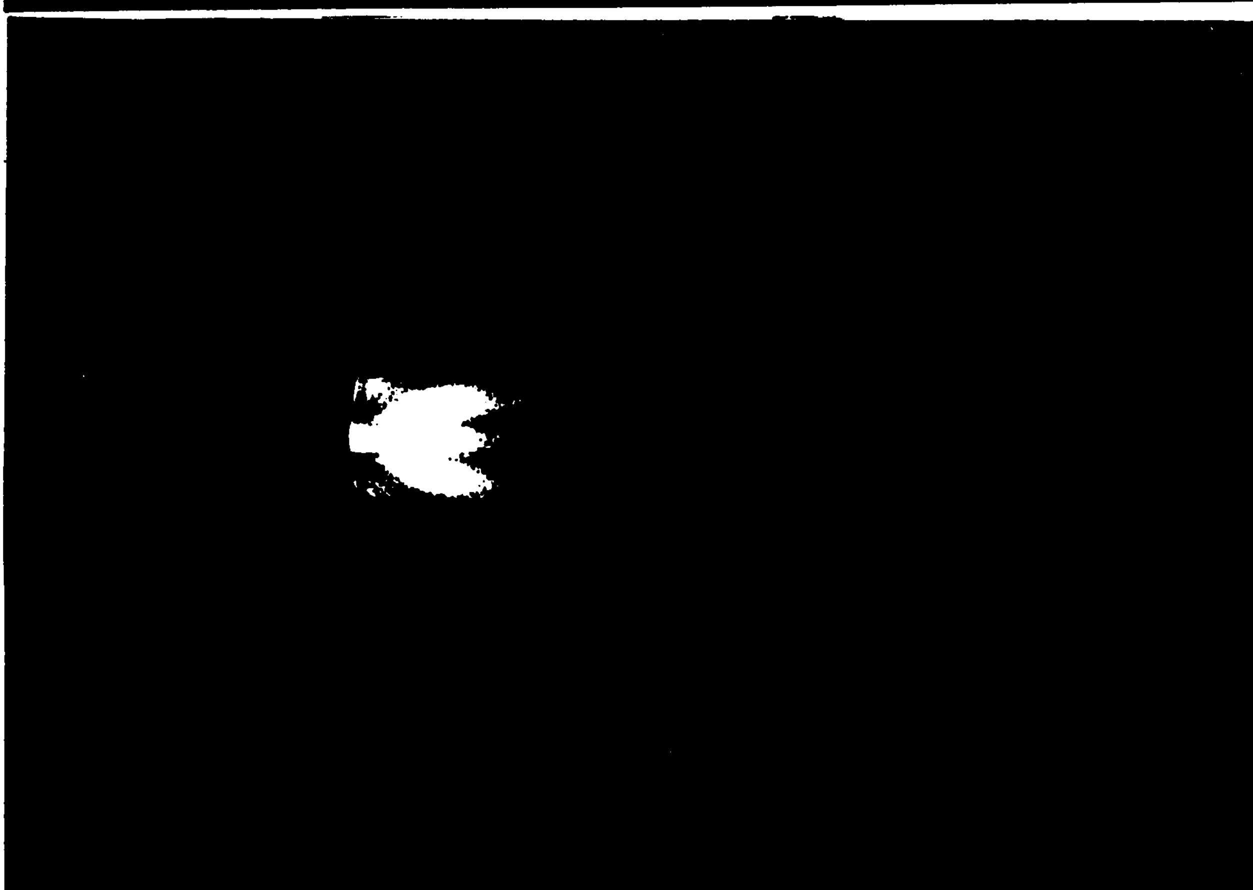
EPPDyL

at Princeton University since 1962

Princeton EP cover MAY '91







RESEARCH FOCUS

~2kW to ~30 kW

* Anode losses are dominant
- Frozen flow losses are present
* Cathode erosion is important

~30 kW to ~ 200 kW

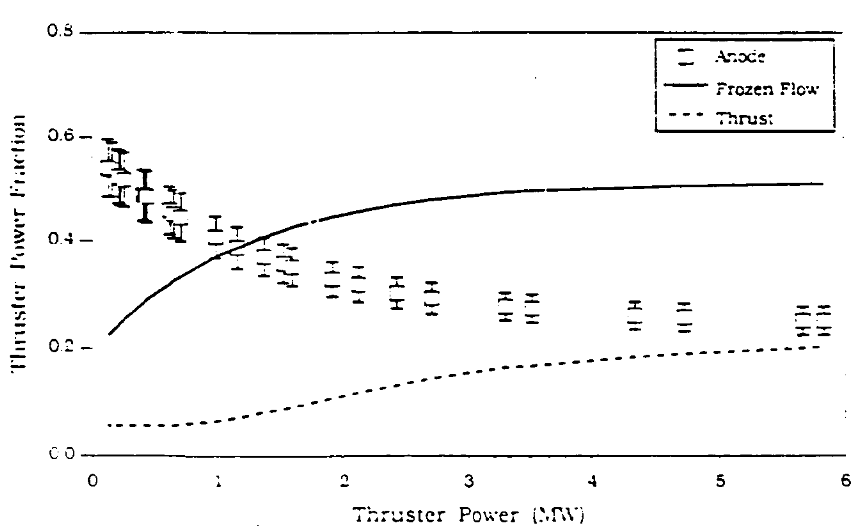
* Anode losses are important
* Frozen flow losses are important
* Cathode erosion is important

≥200 kW-

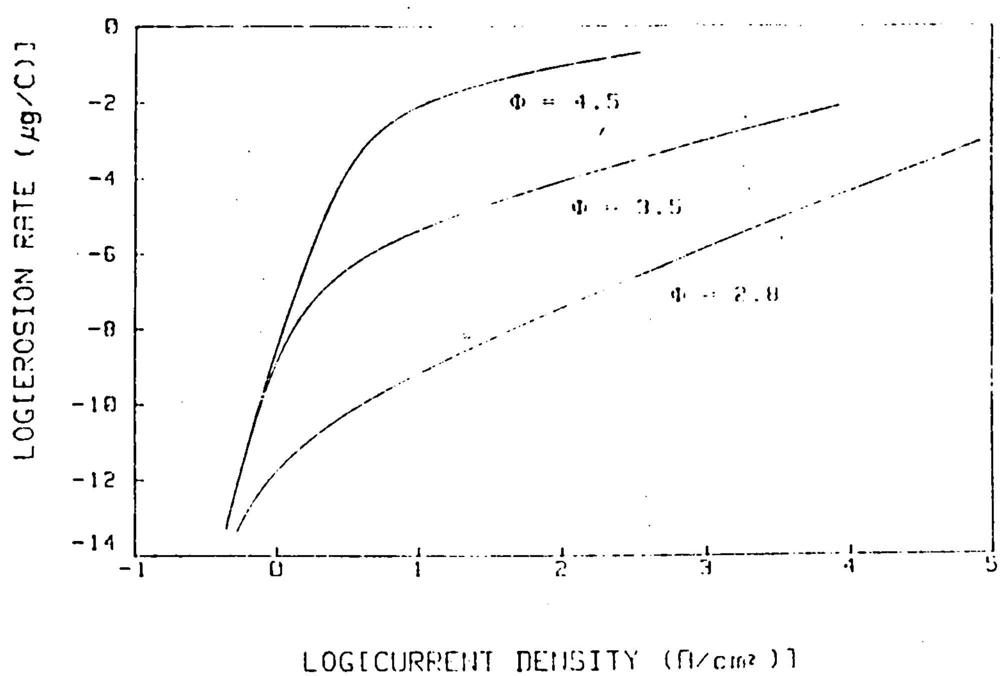
* Frozen flow losses are dominant
- Anode losses; an engineering challenge
* Cathode erosion is important

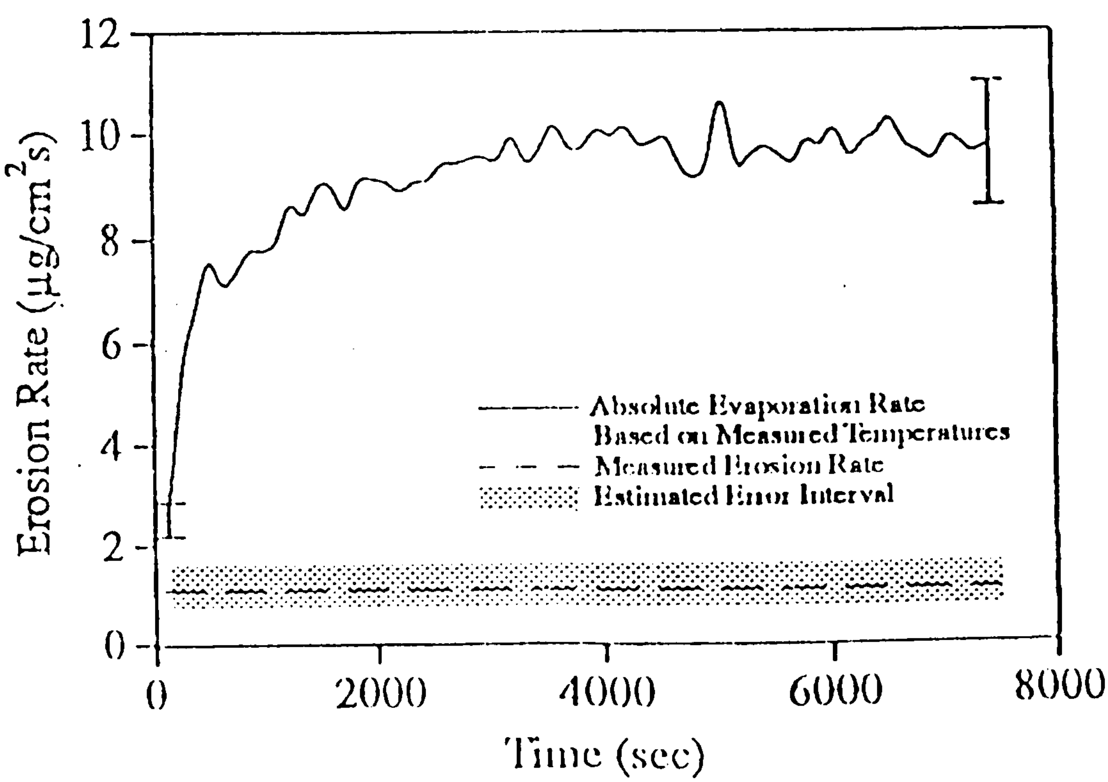
Princeton EP #4 MAY '91

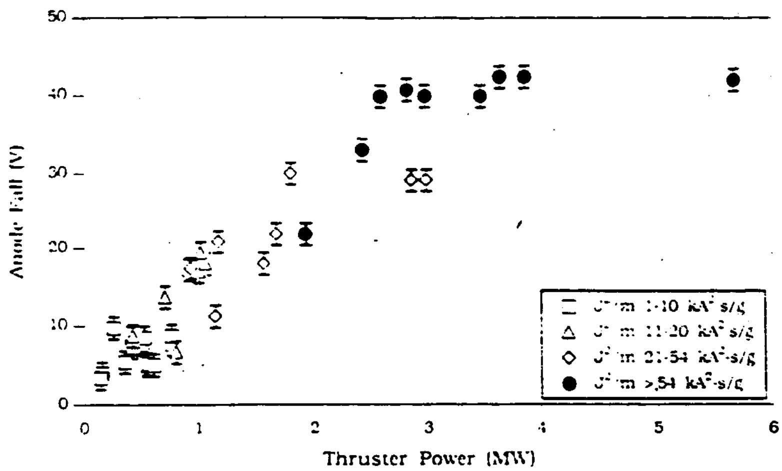
MPD Thruster Power Partitioning

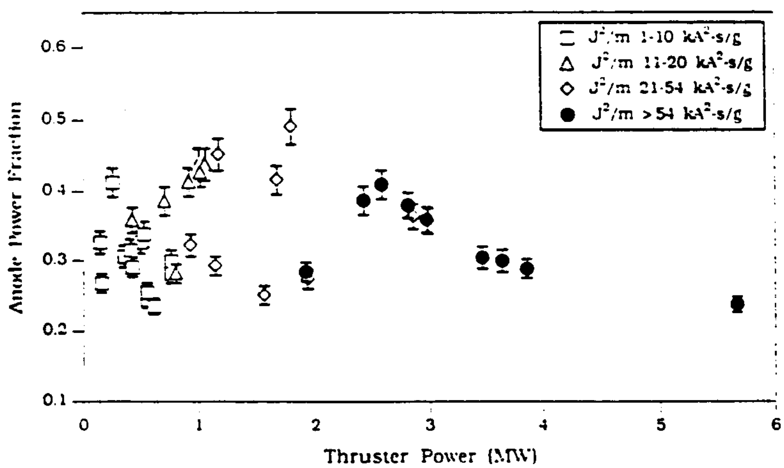


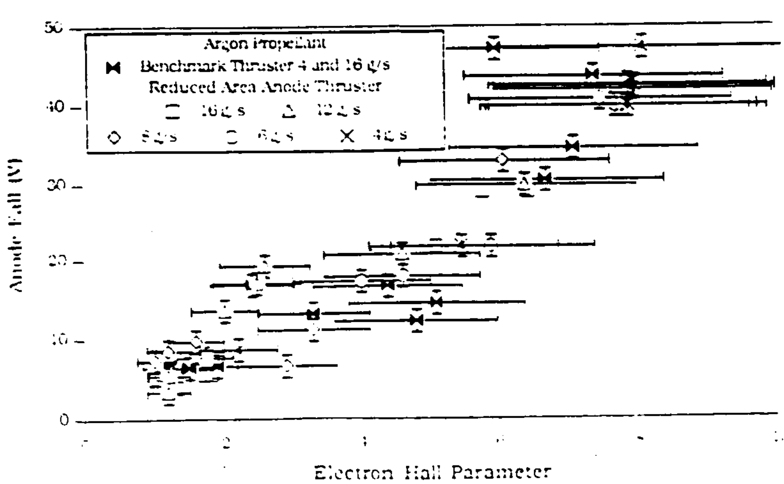
CATHODE EVAPORATIVE MASS LOSS

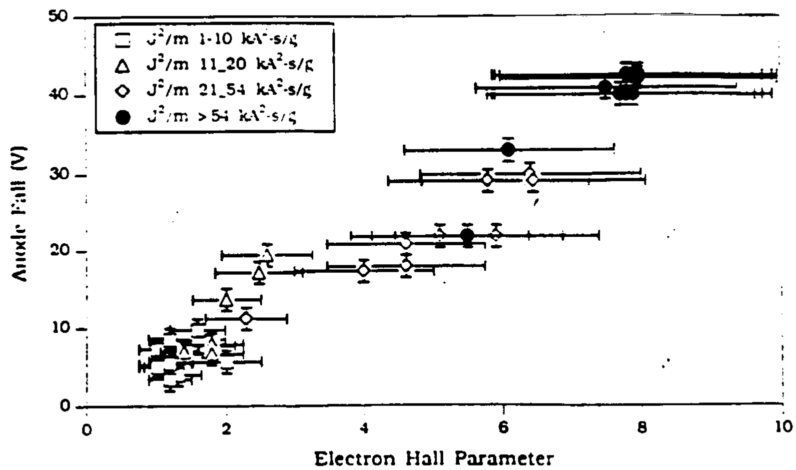





Anode Fall (V)
Thruster Power (MW)
J²/m >54 kA²-s/g


Anode Power Fraction
Thruster Power (MW)
J²/m 1-10 kA²-s/g
J²/m 11-20 kA²-s/g
J²/m 21-54 kA²-s/g
J²/m >54 kA²-s/g


Argon Propellant
Benchmark Thruster 4 and 16 g/s
Reduced Area Anode Thruster
Anode Fall (V)
Electron Hall Parameter



PAST ACCOMPLISHMENTS

1. Detailed kinetic description of electrostatic and electromagnetic stability of current-carrying, collisional and flowing plasma.

2. Dispersion tensor reveals dominant unstable modes of the self-field MPD thruster.

3. Experiments confirm linear current-driven instabilities at levels below "critical" total current.

4. kW-level experiments confirm these instabilities.

CURRENT RESEARCH

1. Estimations of momentum and energy exchange rates between particles and unstable waves.

2. Improved transport models include plasma turbulence effects.

3. Numerical model (2-D MHD vectorized code) of MPD thruster.

4. Evaluation of turbulence suppression by:

    a. Propellant choice and seeding
    b. Better magnetic field topology
    c. Geometry-induced scaling of current density
    d. Active radio frequency turbulence suppression

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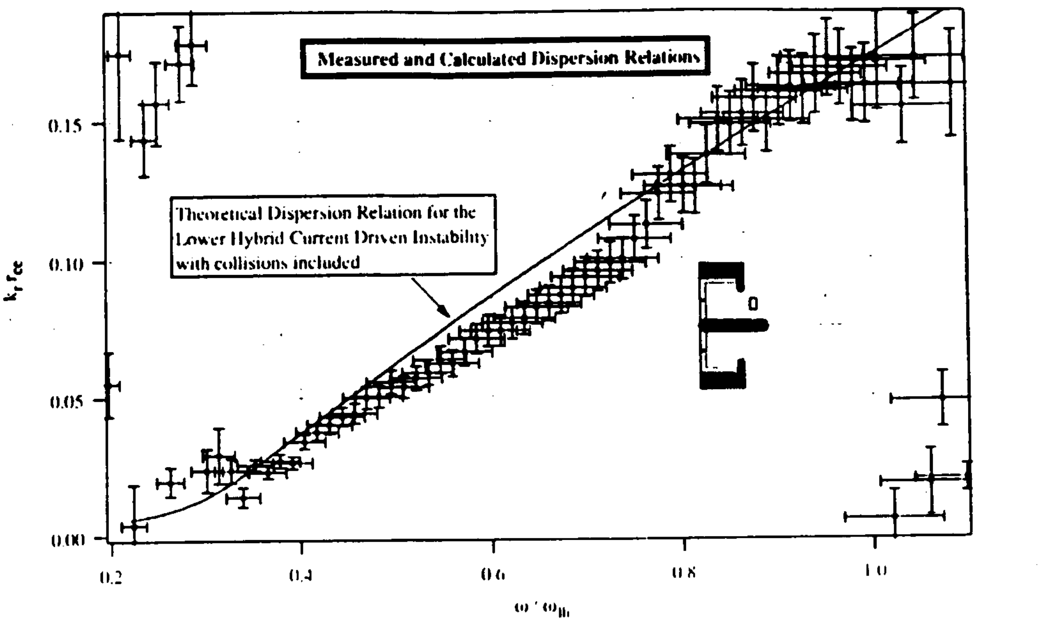
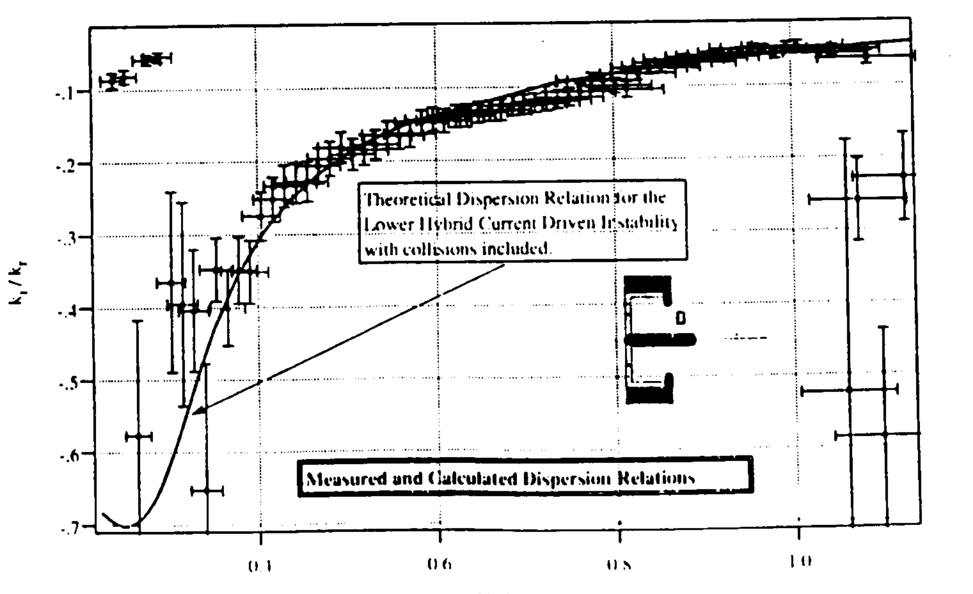


Measured and Calculated Dispersion Relations
Theoretical Dispersion Relation for the Lower Hybrid Current Driven Instability with collisions included
0.15
0.10
0.05
0.00
0.2
0.4
0.6
0.8
1.0



Theoretical Dispersion Relation for the Lower Hybrid Current Driven Instability with collisions included.
Measured and Calculated Dispersion Relations
-.1
-.2
-.3
-.4
-.5
-.6
-.7
0.6
0.8
1.0